Problem sets 1: Data and measuring business cycles

EE312: Intermediate macroeconomics

Semester 1/2018

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Due on January 29th ,2019 at the BE office. (before 3 pm)

1. Consider an economy with two production sectors, namely private consumption sector (PCS) and private investment sector (PIS). The below tables give the total production and price of both sectors in 2017 and 2018. Consider the following problem

Consumption goods

Year	Wine		Cheese	
	price	units	price	units
2017	6	100	10	150
2018	8	100	2	400

Investment goods

Year	Computer		Truck	
	price	units	price	units
2017	200	4	50	13
2018	260	5	60	15

a. Calculate nominal consumption, investment and GDP for 2017 and 2018

Answer: Nominal consumption for 2017 is

(100 cheese wheels)×$6 + (150 wine bottles)×$10 = $2100

Nominal consumption for 2018 is:

(100 cheese wheels)×$8 + (400 wine bottles)×$2 = $1600

Using similar calculations, nominal investment is $1450 in 2017 and $2200 in 2018.

Nominal GDP, therefore, is $3550 in 2017 and $3800 in 2018.

b. Calculate the fixed-base year real consumption using 2017 as the base year. Calculate the private consumption deflator.

The traditional method values 2018 production at 2017 prices (the base year) to get a time-comparable real measure. So, 2018 real consumption (100 cheese wheels)*$6 + (400 wine bottles)*$10 = $4600

c. Calculate the fixed-base year real investment using 2017 as the base year. Calculate the private investment deflator.

In the same way as b, 2018 real investment is $1750

d. Calculate the fixed-base year real GDP using 2017 as the base year. Calculate the GDP deflator.

Real GDP is everything in 2018 production, but valued at 2017 prices. This is $6350.

GDP deflator is nomina/real * 100 = (3550 / 6350) * 100 = 54.19.

e. Does the real GDP equal to the sum between real consumption and real investment?

Yes. Using the fixed-base year method, real GDP is equal to the sum of the two components of real GDP.

f. Redo "b" using the Chain-weighted method

Under the chain-weighted method, we need to calculate the growth of two consecutive periods by varying the base year between 2017 and 2018. Then, we average the growth figures with geometric average method.

Using price in 2017, real consumption growth (implied from the fixed-base year method) between 2017 and 2018 is

(4600 – 2100)/2100 * 100 = 119%

Using price in 2018, real consumption growth (implied from the fixed-base year method) between 2017 and 2018 is

(1600 – 1100)/1100 * 100 = 45.5%

$$\text{Real\_2018} = \$2100 * \sqrt{(1+1.19)(1+0.45)} = \$3{,}742.1$$

g. Redo "c" using the Chain-weighted method

Under the chain-weighted method, we need to calculate the growth of two consecutive periods by varying the base year between 2017 and 2018. Then, we average the growth figures with geometric average method.

Using price in 2017, real investment growth (implied from the fixed-base year method) between 2017 and 2018 is

$$(1750 - 1450)/1450 * 100 = 20.6\%$$

Using price in 2018, real consumption growth (implied from the fixed-base year method) between 2017 and 2018 is

$$(2200 - 1820)/1820 * 100 = 20.8\%$$

$$\text{Real\_2018} = \$1450 * \sqrt{(1+0.206)(1+0.208)} = \$1750.41$$

h. Redo "d" using the Chain-weighted method

Using price in 2017, real GDP growth (implied from the fixed-base year method) between 2017 and 2018 is

$$(6350 - 3\,550)/3550 * 100 = 78\%$$

Using price in 2018, real GDP growth (implied from the fixed-base year method) between 2017 and 2018 is

$$(3800 - 2920)/2920 * 100 = 30\%$$

$$\text{Real\_2018} = 3550 * \sqrt{(1+0.78)(1+0.30)} = \$5{,}400.2$$

i. Reconsider your conclusion obtained in "e" when the Chain-weighted method is used instead.

Notice that if we sum chain-weighted real consumption and real investment, calculated separately for each sector in f and g, we get $5750.41. This is not the same as the answer we got by chain-weighting the whole economy in "h".

This is one caveat when using figures adjusted for inflation with chain-weighted methods. Chain-weighted GDP does NOT generally equal the sum of the chain-weighted figures for each sector separately. However, this property IS true for real GDP calculated the traditional way (see d). Why is this? Unlike the traditional method, where goods are aggregated in a linear way, the aggregation across goods for chain-weighted GDP is nonlinear. Consequently, there is no reason to expect it to be additively separable across sectors.

2. As we discussed in class, the CPI is calculated for a fixed market basket. It measures the change in the cost of the market basket from the base year until the current year. An index with the market basket fixed in the first year, like the CPI, is technically called a *Laspeyres index*. An alternative index, the *Paasche Index*, is based on a market basket in the end year. It measures the change in the cost of a market basket fixed in the end year. Suppose that the base is 2017, and further that the market basket contains only two items, wine and cheese, and the quantities consumed and prices in 2017 and 2018 are

Year	Wine		Cheese	
	price	units	price	units
2017	0.5	50	1	100
2018	2	45	1.2	150

a. Calculate the rate of inflation for the Laspeyres (CPI) index and the Paasche Index.

First consider nominal value of consumption expenditure for each year.

Year 2017 = 0.5*50 + 1 * 100 = 125

Year 2018 = 2*45 + 1.2*150 = 90 + 180 = 270

To get the Laspeyres CPI, we need to know the expenditure required for achieving the original consumption bundle in 2017, but with the current prices. This is equal to 2*50 + 1.2*100 = 220. The Laspeyres CPI is then (220/125)*100 = 176. (when we construct an index, the value in the base year must be converted to 100.) Laspeyres CP inflation is then equal to $\left(\frac{176-100}{100}\right) * 100 = 76\%$

To get the Paasche CPI, we need to know the expenditure required for achieving the current consumption bundle in 2018, but with the old prices. This is equal to 0.5*45 + 1*150 = 172.5. The Laspeyres CPI is then (270/172.5)*100 = 156. Passche CPI inflation is then $\left(\frac{156-100}{100}\right) * 100 = 56\%$

b. Workers often receive an adjustment in their wages equal to only a fraction of inflation as calculated using the CPI. In view of the preceding analysis, explain why workers would likely be better off than they were before if they were fully

compensated for inflation. Would this also be the case if inflation was calculated using the Paasche index?

From the calculation, Lasperyres CPI is higher than that of Passche. Of course, worker would be desirable if the wage increase is tied (indexed) to the Lasperyres CPI inflation.

c. Calculate the CPI inflation using the ideal Fisher index method

The Fisher CPI index is the geometric average between the two CPI measures, and this is equal to $\sqrt{(176)(156)} = 165$. The Fisher inflation is then 65%.

3. Working with the real DATA

We will go through and analyze this problem using the real data. The excel file posted in the Moodle folder contains some data set downloaded from the CEIC database. The file has three sheets, namely "CEIC_data", "data_definition", and "USED_data". The first contains all the raw data originally downloaded from the CEIC. (you can disregard the sheet.) The second sheet lists down all the key variable names with the definition of each one provided. The third sheet gives you the data that covers the period between 1993 and 2018 (the third quarter). Consider the following questions (some of the questions will require your excel skillset.)

a) If we plot the series of nominal GDP in the log-scale, what can we then interpret about the slope of the curve?

We discussed in class. The slope of log-scale figure can be interpreted as the growth rate of the nominal GDP (Q-o-Q growth) while the slope of level figure only measures the change in the level of nominal GDP. If one fits a curve to the log-scale figure, the curve that is most likely fitting the curve is a straight line, i.e. constant "average" growth.

b) Calculate the Y-o-Y growth of both nominal GDP and real GDP during the past four quarters. What does the difference between the two figures obtained from each quarter imply?

	A	B	C	D	E	F	G	H	I
1	Date	GDP_sa	GDP_CVM_sa		GDP_deflator	Y-o-Y growth deflator	Y-o-Y growth nom	Y-o-Y growth real GDP	diff in growth
86	03/2014	3247292.00	2279872.00		142.433084	0.017676816	0.014555548	-0.003067053	0.017622601
87	06/2014	3303982.00	2294584.00		143.9904575	0.024729656	0.034071334	0.009116237	0.024955097
88	09/2014	3316882.00	2315045.00		143.2750551	0.011463961	0.02253763	0.010948159	0.011589471
89	12/2014	3352997.00	2341629.00		143.1907873	0.004514504	0.027506745	0.022888909	0.004617836
90	03/2015	3370948.00	2349881.00		143.4518599	0.007152664	0.038079729	0.030707426	0.007372304
91	06/2015	3399663.00	2360882.00		143.9997001	6.41889E-05	0.028959298	0.028893255	6.60435E-05
92	09/2015	3469397.00	2390920.00		145.1071972	0.012787586	0.045981437	0.032774741	0.013206696
93	12/2015	3501791.00	2409669.00		145.3224904	0.014887152	0.044376419	0.029056695	0.015319724
94	03/2016	3542182.00	2429453.00		145.801627	0.016380178	0.050796986	0.03386214	0.016934846
95	06/2016	3618125.00	2447020.00		147.8584155	0.026796691	0.064259899	0.036485517	0.027774382
96	09/2016	3663572.00	2464804.00		148.635429	0.024314657	0.055967939	0.030901912	0.025066027
97	12/2016	3708438.00	2483233.00		149.3391075	0.027639336	0.059011803	0.030528674	0.028483129
98	03/2017	3780619.00	2512217.00		150.4893487	0.032151368	0.067313594	0.034066928	0.033246666
99	06/2017	3822532.00	2542291.00		150.3577679	0.016903687	0.056495284	0.038933478	0.017561806
100	09/2017	3898817.00	2572491.00		151.5580424	0.019662966	0.064211922	0.043689884	0.020522038
101	12/2017	3950093.00	2582825.00		152.9369198	0.024091562	0.065163554	0.040105781	0.025057773
102	03/2018	4004943.00	2635260.00		151.975251	0.009873804	0.059335257	0.048977855	0.010357402
103	06/2018	4075890.00	2659346.00		153.2666302	0.019346273	0.066280151	0.046043116	0.020237035
104	09/2018	4111373.00	2658895.00		154.6271289	0.020250239	0.054518076	0.033587678	0.020930397
105									
106				sd		0.021060325	0.042156375	0.030001638	0.022051715
107				mean		0.025922791	0.067776791	0.040634208	0.027142584
108									
109				in percent					
110				sd		2.106032515	4.215637524	3.000163788	2.205171516
111				mean		2.592279143	6.777679118	4.063420756	2.714258363

Note in column I that the difference between nominal GDP growth and real GDP growth is roughly comparable to the Y-o-Y growth of GDP deflator. The difference can be used as the *approximation* of GDP deflator inflation.

c) Calculate the investment deflator for both equipment and construction. Show the figures for the past four quarters. (In the real data, investment can be divided into two subcomponents, namely equipment and construction. This question is asking you to calculate the deflator for each type of investment.)

	A	B	C	D	E	F	G	H	I	J
1	Date	GFCF_CON_SA	GFCF_CON_CVM_SA	GFCF_EQUIP_SA	GFCF_EQUIP_CVM_SA		con_deflator	equip_deflator	y-o-y con_deflator	y-o-y equip deflator
85	12/2013	254592.00	166133.00	529818.00	372155.00		153.2458934	142.3648749	0.008321793	0.030032497
86	03/2014	246979.00	162139.00	535879.00	374996.00		152.3254738	142.902591	-0.013858625	0.06616759
87	06/2014	261247.00	170408.00	563777.00	396058.00		153.3067696	142.3470805	0.013060276	0.053796565
88	09/2014	264211.00	174187.00	601510.00	416325.00		151.6823873	144.4808743	0.013567826	0.022351731
89	12/2014	267312.00	171260.00	529116.00	386646.00		156.0854841	136.8476591	0.018529637	-0.038754052
90	03/2015	282304.00	188681.00	543668.00	393356.00		149.6197285	138.2127132	-0.017762921	-0.032818704
91	06/2015	287007.00	192984.00	539428.00	380313.00		148.7206193	141.8379072	-0.029914858	-0.003576984
92	09/2015	285256.00	195376.00	555846.00	386153.00		146.0036033	143.9444987	-0.037438651	-0.003712433
93	12/2015	308630.00	208828.00	570526.00	396144.00		147.7914839	144.0198514	-0.05313755	0.052410047
94	03/2016	304454.00	208046.00	569648.00	395328.00		146.3397518	144.0950299	-0.021922087	0.042559882
95	06/2016	307943.00	211680.00	554373.00	384047.00		145.4757181	144.3503009	-0.021818772	0.017713133
96	09/2016	300897.00	208711.00	557884.00	382890.00		144.1692101	145.7034657	-0.012564027	0.012219759
97	12/2016	311898.00	220049.00	577445.00	394513.00		141.7402488	146.3690677	-0.04094441	0.016311754
98	03/2017	313029.00	211938.00	585156.00	396437.00		147.6983835	147.6037807	0.009284092	0.024350255
99	06/2017	295483.00	203194.00	592621.00	398474.00		145.4191561	148.7226268	-0.000388807	0.030289691
100	09/2017	302281.00	206181.00	589921.00	397270.00		146.6095324	148.4937196	0.016926793	0.019150223
101	12/2017	300737.00	207687.00	600298.00	404282.00		144.8029968	148.4849684	0.021608175	0.014455928
102	03/2018	319318.00	213428.00	603454.00	412876.00		149.6139213	146.158653	0.012969254	-0.009790587
103	06/2018	308460.00	209494.00	610035.00	416331.00		147.2404938	146.5264417	0.012524744	-0.014766987
104	09/2018	321089.00	215417.00	618110.00	412585.00		149.0546243	149.8139777	0.016677578	0.008891003
105						2000-onwards				
106						sd			0.044393267	0.054299982
107						mean			0.024379115	0.033960714
108										
109						in percent				
110						sd			4.439326693	5.429998217
111						mean			2.437911464	3.396071444

The figures of past four quarters are given in column G, and H. They can be obtained by having each respective type of nominal investment divided by its corresponding value measured in the real term. I supplement two additional columns with the growth of investment deflator. Compared to the volatility of gdp deflator inflation, investment deflator inflation is more volatile.

d) Calculate the core inflation and non-core inflation using the data between 2000 and 2018. What is the value of the standard deviation of both inflation measures, and its correlation?

	A	B	C	D	E
1	Date	**NONCORE_CPI**	**CORE_CPI**	noncore_cpi inflation	core inflation
89	12/2014	104.28	99.39	-0.002741473	0.006923103
90	03/2015	100.21	99.77	-0.054680376	0.009170909
91	06/2015	100.97	99.96	-0.06350286	0.00925552
92	09/2015	100.04	100.09	-0.062537094	0.00907319
93	12/2015	98.76	100.20	-0.052934407	0.008149987
94	03/2016	96.55	100.47	-0.036588611	0.007049547
95	06/2016	99.97	100.69	-0.009870919	0.00736986
96	09/2016	98.92	100.77	-0.011162574	0.006727055
97	12/2016	99.32	100.84	0.00563656	0.006387438
98	03/2017	99.37	100.86	0.029277724	0.003815274
99	06/2017	99.05	100.92	-0.009269138	0.002284163
100	09/2017	99.26	101.05	0.003437121	0.002811776
101	12/2017	100.89	101.28	0.015841584	0.004429606
102	03/2018	100.05	101.38	0.006775795	0.005221932
103	06/2018	101.87	101.56	0.028471428	0.006308419
104	09/2018	102.57	101.64	0.033313184	0.005838694
105					
106			SD	0.054943676	0.008478321
107			mean	0.048109015	0.006996505
108					
109			correlation	0.344946731	
110					
111			in percent		
112			SD	5.49436764	0.847832075
113			mean	4.810901544	0.699650514

Core inflation SD is 0.84% while non-core inflation SD is 5.49%. The non-core inflation is approximately 6.5 times higher than that of core inflation. As

explained in class, this is because of the nature of product that gets classified in under the non-core component, i.e. food and energy. The prices of two items are highly volatile and largely dominated by supply factors.

e) In the table, we have real GDP data for 5 countries – Thailand, USA, Euro, Australia, Brazil, and Japan. Calculate the Y-o-Y growth of real GDP each country, report the standard deviation of each series and show the pairwise correlation. Use the data between 2000 and 2018.

f) From "e", do you find the perfect correlation among any pairwise figures obtained? Can you attribute this to any reason that might explain the finding? How tightly do Thai GDP growth comove with US GDP growth? Compare with the figure obtained with respect to Japan GDP growth.

	A	F	G	H	I	J	K	L	M	N
1	Date	GDP_BRAZIL_CVM_SA	GDP_JPN_CVM_SA		Y-o-Y GDP_CVM_sa	Y-o-y GDP_USA_CVM_SA	Y-o-y GDP_EURO_CVM_SA	Y-o-y GDP_AUS_CVM_SA	Y-o-y GDP_BRAZIL_CVM_SA	y-o-y GDP_JPN_CVM_SA
93	12/2015	165.56	515526.30		0.029056695	0.020000064	0.02251109	0.027199636	-0.054851227	0.010222816
94	03/2016	164.13	519064.90		0.03386214	0.015568472	0.021116336	0.027474171	-0.054054839	0.004055374
95	06/2016	164.14	519170.80		0.036485517	0.012959512	0.019669379	0.03327856	-0.032098223	0.002828824
96	09/2016	162.84	520796.80		0.030901912	0.015362466	0.018642854	0.023071473	-0.025206794	0.005693558
97	12/2016	162.38	521727.70		0.030528674	0.018787567	0.021028853	0.0274126	-0.019223295	0.01202926
98	03/2017	164.15	525940.50		0.034066928	0.019382626	0.02211386	0.021859729	9.76716E-05	0.013246128
99	06/2017	165.07	528672.40		0.038933478	0.021147073	0.025162602	0.021409307	0.005669374	0.018301492
00	09/2017	165.68	532164.70		0.043689884	0.023388767	0.027981945	0.028191847	0.01744923	0.021827899
01	12/2017	165.94	534127.50		0.040105781	0.024717073	0.026362142	0.023776922	0.021902725	0.023766804
02	03/2018	166.20	532396.90		0.048977855	0.025804143	0.023297482	0.030119883	0.012510605	0.012275913
03	06/2018	166.50	536036.70		0.046043116	0.028698066	0.021691816	0.031233314	0.008668114	0.013929798
04	09/2018	167.76	532648.20		0.033587678	0.030027852	0.018212203	0.027682008	0.012560325	0.000908553
05										
06				sd	0.030001638	0.016423449	0.018485646	0.00917811	0.031885764	0.021793982
07				mean	0.040634208	0.020582613	0.01600163	0.029373505	0.024639295	0.00942942
08										
09				correlation		0.476904796	0.366525401	0.341483187	0.366362568	0.541488077
10				with country						
11										
12										
13				in percent						
14				sd	3.000163788	1.642344923	1.848564563	0.917811047	3.18857636	2.17939821
15				mean	4.063420756	2.05826127	1.600162979	2.93735054	2.463929523	0.942941985

You can see details in the excel. What's interesting is the stylized facts of average growth, volatility and correlation across different countries. First things first. Note first that the average growth of advanced economy is typically lower than those emerging markets. (see average growth figures of each country. Ours is roughly 4%; those other advanced nations have lowered growth.) Empirically, growth tends to decline as countries move from middle income to high income countries. (Japan might be a special case. Their GDP growth has been very low, average of 0.9%. This is due to the structural problem of Japan. Historically, they were hit by recession in the early of 90s', and they economy has remained under sluggish condition since then. In recent years, they've been trying hard to promote many aggressive growth policies to push up their growth rate. The result is yet to be seen.) Secondly, volatility

of growth in emerging markets (Thailand and Brazil) are normally higher than those developed countries. This can imply that our business cycle fluctuations are more severe than those developed nation. Third, pairwise correlation is far from perfect, though they are positive. This suggests that there are lot more of the factors that determine Thai GDP. External factors are important, but country-specific factors are no less important as well. (Think about the Flooding that hit Thai economy in 2011, causing our GDP growth to drop below its average. In the same year, other countries in the world remained healthy as they didn't get impacted with the same kind of problem that we faced.)